EFFECT OF WINTER NUTRITION AND LACTATION ON OVULATION AND OVULATION RATE IN EWES IN AUTUMN

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SUMMARY

The effect of undernutrition during July-September on oestrus and ovulation rate in Janury-April was investigated in lactating and dry Corriedale ewes. The low levels of nutrition imposed from July resulted in a 5 to 10 kg difference in liveweight in September but thereafter liveweights had equilibrated with control ewes by December. This undernutrition decreased the probability of ovulating early in the breeding season but had no effect on the proportion of ewes with multiple ovulations at any time. The effect of lactation in July-September resulted in a lower incidence of oestrus and also reduced ovulation rate in the following Autumn. It is concluded that following a Winter drought producers ought to delay joining or extend the normal joining period.

INTRODUCTION

Although the immediate effects of nutrition at joining on oestrus and ovulation rate have been well documented (Killeen 1967), the effects of previous nutrition some six months prior to joining have not been fully investigated. Smith (1962, 1966) reported that restricted nutrition during Spring reduced the incidence of oestrus in Merino ewes during the following Autumn. Fletcher (1974) subjected ewes to different levels of nutrition during Winter and found no effect on the incidence of oestrus in Spring but ewes on the lowest plane of Winter nutrition had a 30% lower ovulation rate in Autumn. There is good physiological evidence to suggest that nutritional status six months prior to joining may be important since Cahill & Mauleon (1980) have shown that it takes six months from when an ovarian follicle begins to grow and develop until ovulation. Of this six months the first 4½ months is in the pre-antral phase and the last six weeks is spent in the antral phase when follicles are highly sensitive to many hormonal influences (Moor, Cahill & Stewart, 1980) and nutritional effects (Cumming 1972). The present study investigates the influence of nutrition during Winter-Spring in lactating or dry ewes on the incidence of oestrus and ovulation rate in the following late Summer-Autumn.

MATERIALS AND METHODS

In February 1982, a flock of 5½ year old Corriedale ewes was allotted at random, after stratification according to liveweight, into two groups, one of which was joined to Corriedale rams while the other group remained unjoined. From February until July both groups of ewes maintained good condition grazing annual grass and clover pastures. Two weeks after lambing in July each lactating ewe with one lamb (Lactating ewes) was allotted at random to one of two subgroups and fed either a maintenance-lactation (ML, 81 ewes) or half maintenance-lactation (ML/2, 44 ewes) ration. The lactating ewes were fed in a feedlot in lots of 20 ewes and lambs and all lambs were weaned on October 5. The unjoined ewes (Dry ewes) commenced their nutritional treatment at the same time as the lactating ewes and were placed in individual pens and fed either a maintenance (M, 50 ewes), half-maintenance (M/2, 46 ewes) or one third maintenance (M/3, 49 ewes) ration. All ewes were placed on a maintenance ration from September 14. The ration consisted of crushed barley and lucerne, (1:1 W/W) made into a pellet. The maintenance ration in a pre-trial was determined to be 15 gm/kg liveweight for dry ewes and calculated to be 37.25 gm/kg liveweight for lactating ewes.

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From immediately prior to lambing, all ewes were weighed weekly. Endoscopy was carried out on a sample of 100 ewes on 15 December (when the ewes were still anoestrous) and on all ewes 19 Jan, 15 Feb, 26 Mar, and 26 Apr. when the experiment terminated.

The statistical model for each endoscopy date was :

$$\text{Logit}(P) = \ln[P/(1-P)] = a + b\,LW_t + c\,LW_6 + d\,LW_{6-5} + e\,LS \text{ where :}$$

P=1, expected probability of at least 1 ovulation or
P=2, expected probability of a multiple ovulation
a= constant (intercept), b, c, d, & e = coefficients.
LW_t = liveweight at endoscopy (kg)
LW_6 = liveweight 6 months prior to endoscopy (kg)
LW_{6-5} = liveweight change from 6 to 5 months prior to endoscopy (kg/day)
LS = lactating status, July - 5 October (1 = lactating, 0 = dry).

Back transformation of logit (P) gives

$P = e^z/(1+e^z)$ where z = set of independent variables.

The main effect terms were adjusted for the three remaining main effect terms. The GLIM program (Baker & Nelder 1978) was used for maximum likelihood estimation of the coefficients. The deviance which is a measure of the goodness of fit of the model was assumed to have a χ^2 distribution; the null and residual deviances are when none and all independent variables are fitted respectively.

RESULTS

The mean ($\pm$ s.e.m.) liveweight at the start of the nutritional treatments in July was 48.0 ± 0.3 kg and the largest difference in mean liveweight between maintenance and below maintenance groups was in September being -4.8, -7.1 and -10.8 kg per ewe for the M/2, M/3 and ML/2 groups respectively (Fig.1). Mean liveweights for each group equilibrated in December and continued to rise while endoscopies were carried out.

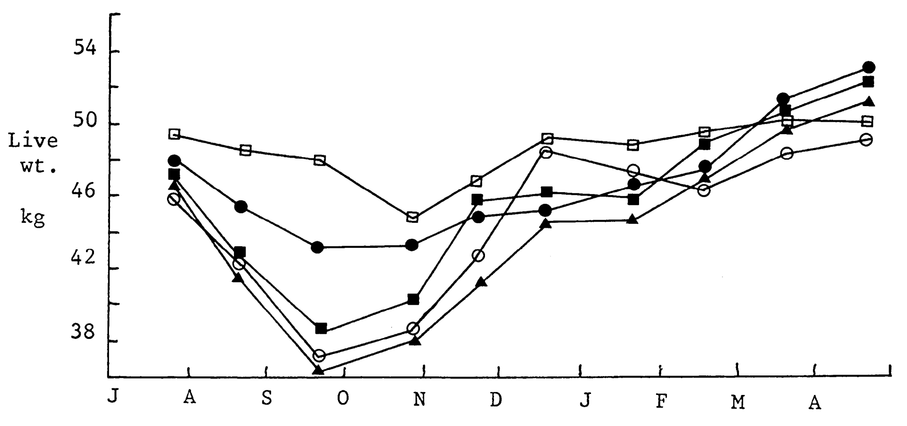

Fig.1. Mean liveweights for dry ewes on maintenance (●—●) half maintenance (■—■) or one-third maintenance (▲—▲) and lactating ewes on maintenance (□—□) or half maintenance (○—○) rations.

Of the 270 ewes, the overall percentages of ewes ovulating were 2, 44, 65, 99 and 99% in Dec., Jan., Feb., Mar., and Apr. respectively and the percentages of ewes with multiple ovulations were 0, 4, 14, 50 and 61% respectively.

TABLE 1 Coefficients (β) and deviances (D-distributed as X^2) for logit (probability of ovulation or multiple ovulation) at each of four endoscopies on 19 Jan., 15 Feb.', 22 Mar., and 26 Apr. (df is 1 for each term, 269 for null dev. and 265 for res. dev.)

Parameter	Month	Constant	TERM + LW_o	LW_6	LW_{6-5}	LS	Null dev.	Res. dev.
Logit probability of ovulating	Jan – β	-3.07	-0.02	0.08	1.95	0.25	370	359
	– D	–	0.4	4.1*	3.4	0.9	–	–
	Feb – β	-0.04	-0.02	0.08	3.55	-2.33	350	291
	– D	–	0.5	3.7	4.2*	58.0***	–	–
	Mar – β	3.17	-0.12	0.23	25.00	-1.60	42	32
	– D	–	1.1	2.4	8.3**	1.0	–	–
	Apr – β	-5.33	0.03	0.20	16.18	-1.33	42	30
	– D	–	0.1	1.4	4.3*	0.9	–	–
Logit probability of multiple ovulation	Jan – β	-8.02	-0.01	0.11	-0.68	-0.19	98	93
	– D	–	0.0	1.2	0.1	0.1	–	–
	Feb – β	-5.48	0.13	-0.06	-3.59	-2.84	216	172
	– D	–	4.9*	0.7	1.7	26.3***	–	–
	Mar – β	-3.58	0.10	-0.03	-1.64	-0.69	374	347
	– D	–	10.3**	0.9	0.6	5.6**	–	–
	Apr – β	-0.39	0.04	-0.03	0.83	-0.42	361	352
	– D	–	1.8	0.6	0.2	2.2	–	–

+ See text for definition of terms
* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$

Probability of ovulating. The probability of a ewe ovulating (Table 1) was significantly decreased, firstly in January by a decreased liveweight 6 months prior to endoscopy and this effect diminished as the season progressed and secondly, by a liveweight decrease 6 to 5 months prior to endoscopy. Extrapolation of the model shows the large effect liveweight 6 months prior to endoscopy has on the probability of ovulation (Table 2) such that a mean increase in liveweight of 10kg increases the probability of ovulating by 0.2 early in the breeding season.

TABLE 2 Probability of ovulation as affected by liveweight 6 months prior to endoscopy (LW_6). (LW_0 = 50 kg; LS = 1 and LW_{6-5} = 0 kg/day)

Term LW_6(kg)	Probability of ovulation at: Jan.	Feb.	Mar.	Apr.
40	.35	.35	.99	.95
50	.56	.54	1.00	.99
60	.75	.72	1.00	1.00

Multiple ovulations. The probability of a multiple ovulation significantly increased with heavier liveweights at the time of endoscopy in February and March. There was no effect of liveweight 6 months prior to endoscopy on the probability of multiple ovulations at any time. Lactation had a severe depressing effect on the probability of multiple ovulations particularly in February and March. Extrapolation from the present study shows that a lactating ewe whose liveweight is 45 kg 6 months prior to and 60 kg at endoscopy has a probability of having a multiple ovulation in Feb., Mar., and Apr. of 0.05, 0.62 and 0.60 compared to a dry ewe, of 0.47, 0.77 and 0.70 respectively.

DISCUSSION

The major findings of the present study concern the effect that previous nutrition has on the incidence of ovulation and the depressing effect that lactation has on the following breeding season. In the present study the probability of ovulating was depressed early in the breeding season by a low level of nutrition 6 months earlier and by whether ewes had lost liveweight between 6 and 5 months prior to endoscopy. These findings support the work of Smith (1962, 1966) and Hunter (1962) but do not agree with Fletcher's (1974) study. In this latter study the ewes were S.A. Merinos with 90% cycling in August thus the effect of previous nutrition on the onset of the breeding season is not relevant. The implications of the present study are of importance after a Winter drought where even though ewes gain condition during Spring, joining in Summer-Autumn ought to be delayed and/or the period of joining extended.

The lack of effect of previous nutrition on the proportion of multiple ovulations in the present study does not conform with the results of Fletcher (1974) who although he measured ovulation rate in February the ewes had been ovulating for in excess of 6 months and the duration of nutritional stress was longer than that of the present study. The present results would also suggest that nutrition has no effect on the number of pre-antral follicles or that nutrition does effect the number of pre-antral follicles but the animal is able to compensate and alter the rate of follicles enter the antral phase and ovulate.

The effect of lactation on the subsequent incidence of oestrus and multiple ovulations was independent of liveweight. This 'penalty' incurred by lactation on subsequent performance ought to be studied for example, where lactation is even a heavier burden with twin lambs. This finding may explain the reason why some flockmen have noticed that some ewes have twin lambs in alternate years.

ACKNOWLEDGEMENTS

The authors acknowledge the assistance of Messrs. Toohey, Parr, Williams, Kerton, McPhee, Staples, Squires, Leach, Campbell and Langdon. This work was supported by the Wool Research Trust Fund.

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